GuardianRx: An AI-Driven Predictive Tool for Monitoring Emerging Psychoactive Drug Trends

Authors: Dip Patel, Balasree S. Pillai, Roopa Foulger, Christopher S. Gondi, Safura Sultana, Rima Shrestha

Dip Patel, PharmD | OSF HealthCare
Dip.Patel@osfhealthcare.org

Rima Shrestha, PhD | UIC College of Medicine Peoria
rdshrest@uic.edu

Presenters

- Dip Patel
  - Clinical Pharmacist at OSF Healthcare
  - Doctor of Pharmacy degree from St. Louis College of Pharmacy (USA)

- Rima Shrestha
  - Assistant Professor at UIC College of Medicine Peoria
  - PhD in Epidemiology and Public Health from Massey University (New Zealand)
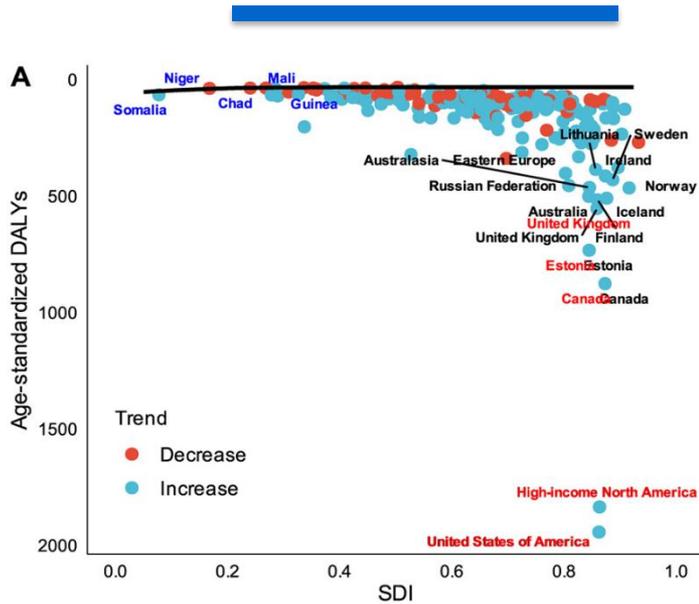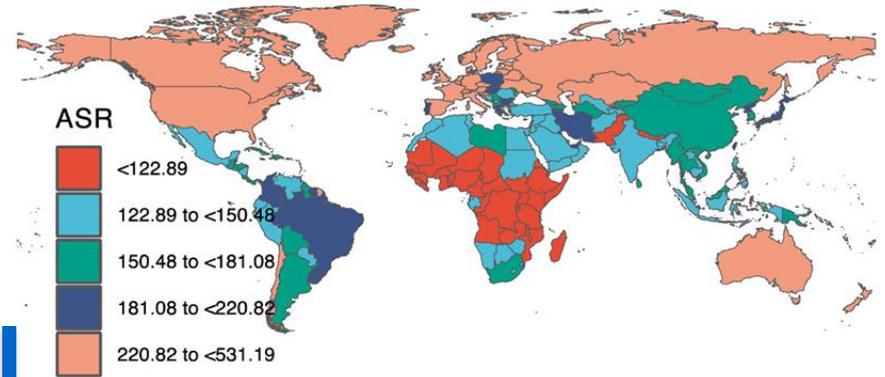
Overview

- Introduction
- Methodology
- Results
    - Demographic Analysis
    - Digital Footprints and Sentiment
    - Correlation between Search Activity and Admissions
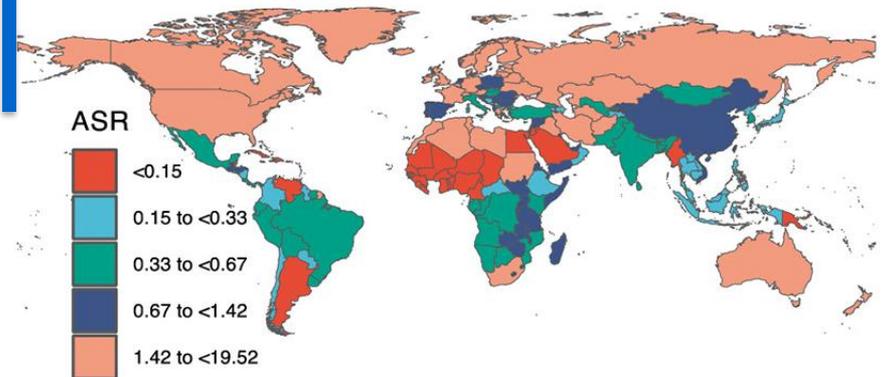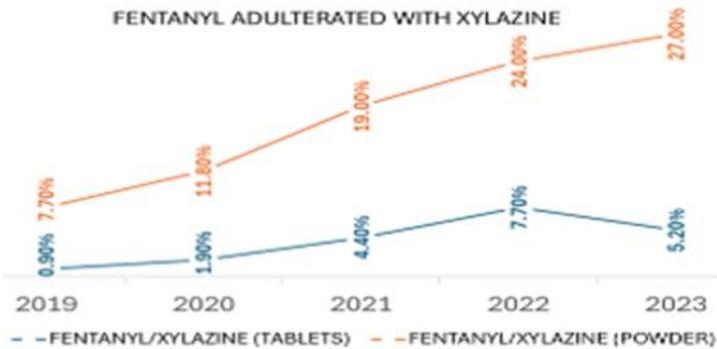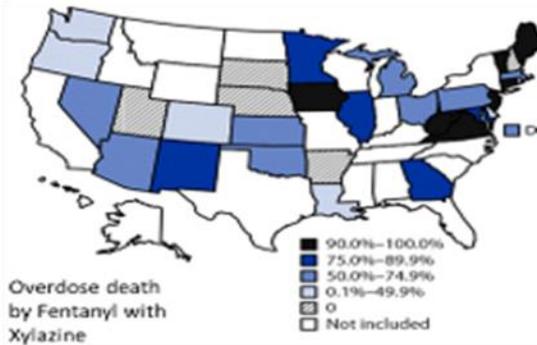- Conclusion
- Future Work

Introduction
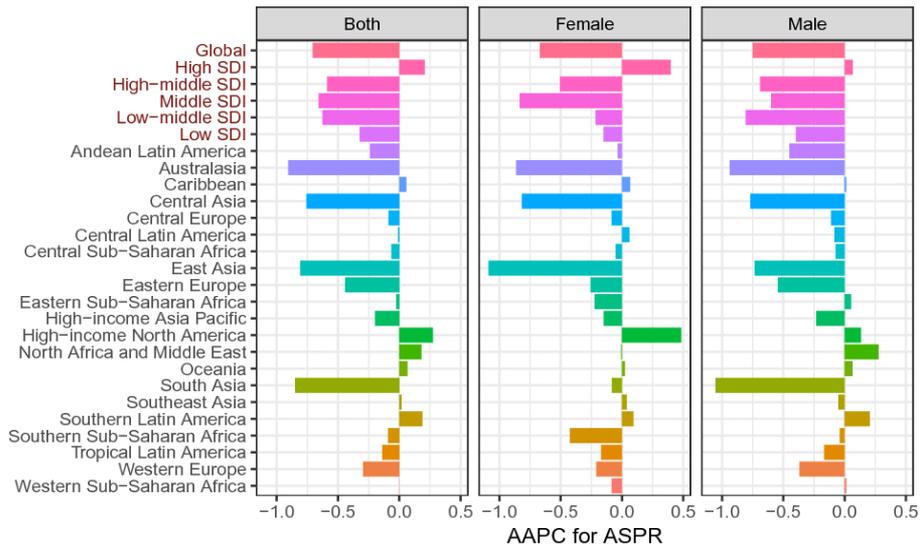
Sex-stratified AAPCs in age-standardized prevalence rates
(Chen et al., 2025 & Chen et al., 2025; SDI: Socio-demographic Index)

Introduction

Overdose death by Fentanyl with Xylazine
- 90.0%–100.0%
- 75.0%–89.9%
- 50.0%–74.9%
- 0.1%–49.9%
- 0
- Not included

FENTANYL ADULTERATED WITH XYLAZINE

- — FENTANYL/XYLAZINE (TABLETS)
- — FENTANYL/XYLAZINE (POWDER)

FENTANYL/XYLAZINE (POWDER): 7.70%, 11.80%, 19.00%, 24.00%, 27.00%
FENTANYL/XYLAZINE (TABLETS): 0.90%, 1.90%, 4.40%, 7.70%, 5.20%

2019, 2020, 2021, 2022, 2023

Topics & Tools > Workplace News & Trends > All Things Work > The COVID-19 Crisis Has Brought Substance Abuse to Light

FEATURE

The COVID-19 Crisis Has Brought Substance Abuse to Light

Alcohol and drug use surged during the pandemic, forcing substance use disorders—one of the last taboo subjects in corporate America—into the spotlight.

October 2, 2021 | Theresa Agovino

'IT EATS UP YOUR FLESH'
'Tranq' brings new horrors to opioid crisis

(Thekkemuriyi et. Al., 2024)

Prior research underscores the critical need for predictive tools in monitoring and addressing drug abuse trends, particularly concerning novel psychoactive drugs (NPDs).

Methodology

GENERATIVE AI	GOOGLE ANALYTICS	HEALTHCARE DATA	OTHER DATA
Compiled online chatter behaviors on substance use in Illinois using AI platforms such as ChatGPT, Meta etc.	8 Key terms of substance use searched	656 ICD codes run Notes search for substance use	Substance use, spatial, and socio-economic data gathered
NLP techniques	Correlation, Spatial and temporal distribution and trends	Correlation, Spatial and temporal distribution and trends	Epidemiological Association and spatial and temporal distribution, and trends

Methodology

1. Data Ingestion

- **OSF Clinical Data** (43k+ Admissions)
- **Google Trends** (Search Vol & DMA)
- **GenAI Simulations** (7,169 Chat Lines)

2. GuardianRx AI Core

- NLP & Sentiment Analysis
- Statistical Modeling
- Spatial Analysis
- DATA INTEGRATION LAYER

3. Public Health Action

- **Spatial Risk Models** (Outbreak Likelihood)
- **Hotspot ID** (Target Communities)
- **Intervention** (Resource Deployment)
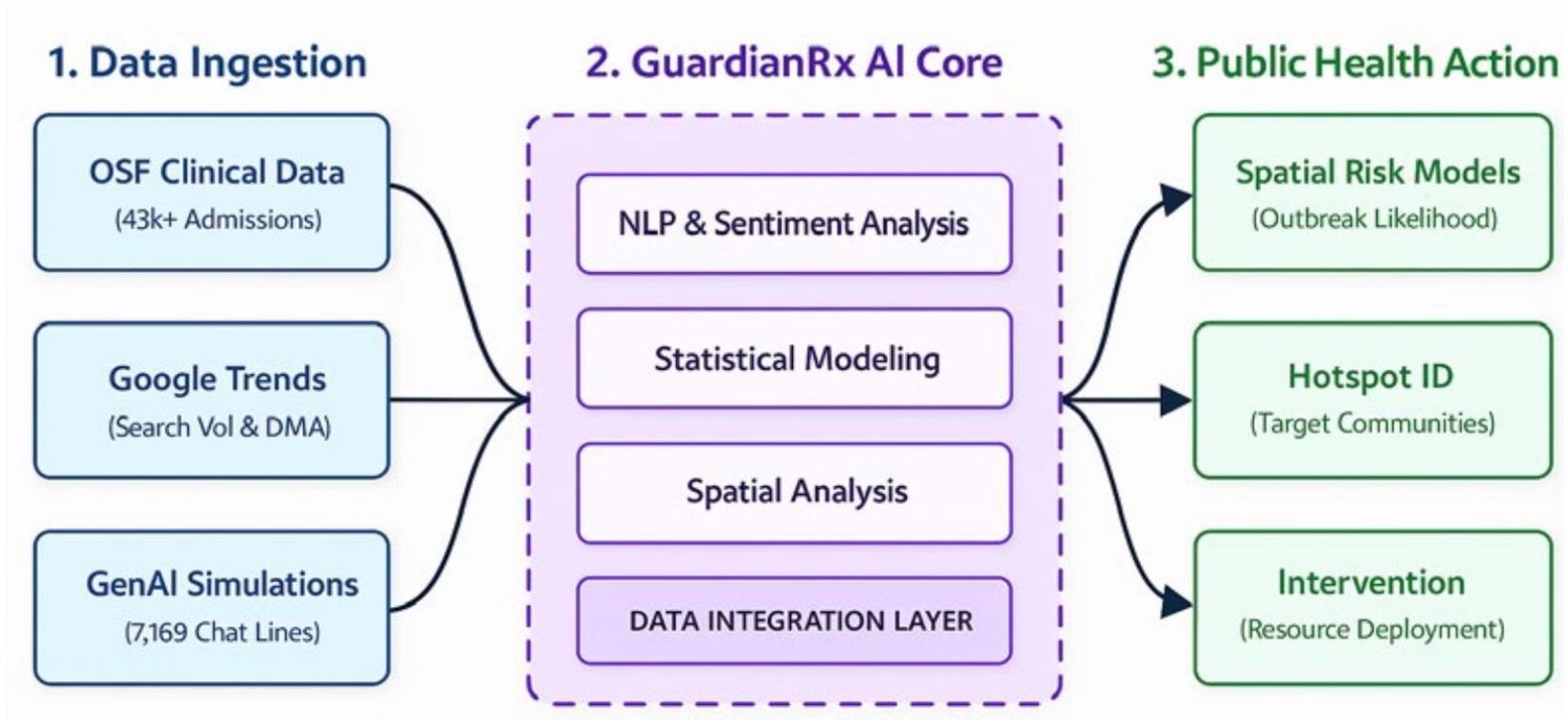
Results

De-identified 40,349 of 43,419 substance use admissions data from 27,694 adult patients in Illinois between 2015 and 2024 in the OSF hospital systems.

Most patients were aged 25 or above (mean 46.8 ± 16.9 years, 90.1%), single (55.8%), non-Hispanic white(69.2%), and resided in urban areas (88.5%).

Racial composition of the cohort, predominantly Non-Hispanic White (69.2%).

Residential distribution highlights a significant prevalence of admissions from urban areas (88.5%) compared to rural locations.

Marital status, with 55.8% of the population identified as single.
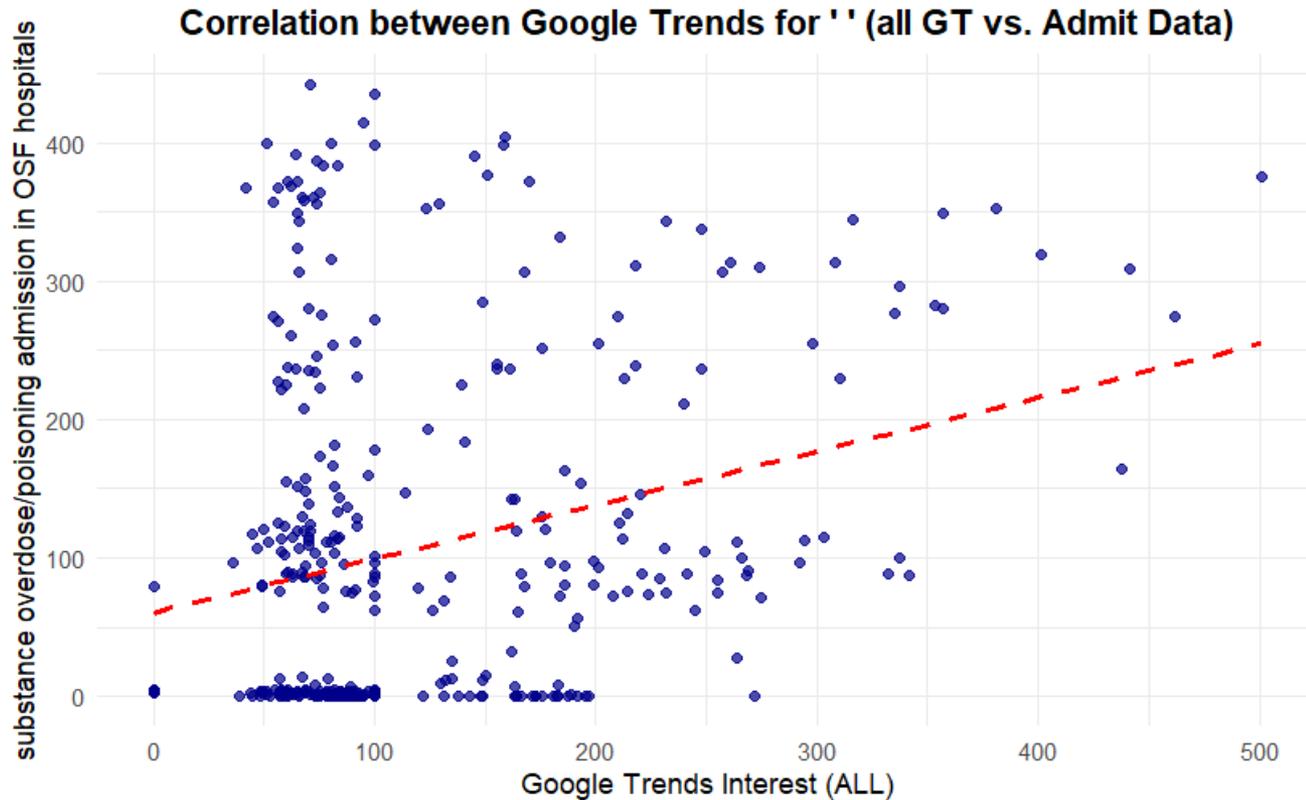
Results

Obtained 7,169 simulated online chat lines related to substance use in Illinois.

A positive correlation was observed between peak search activity and subsequent hospital admissions (r=0.26 to 0.54; P<0.05).
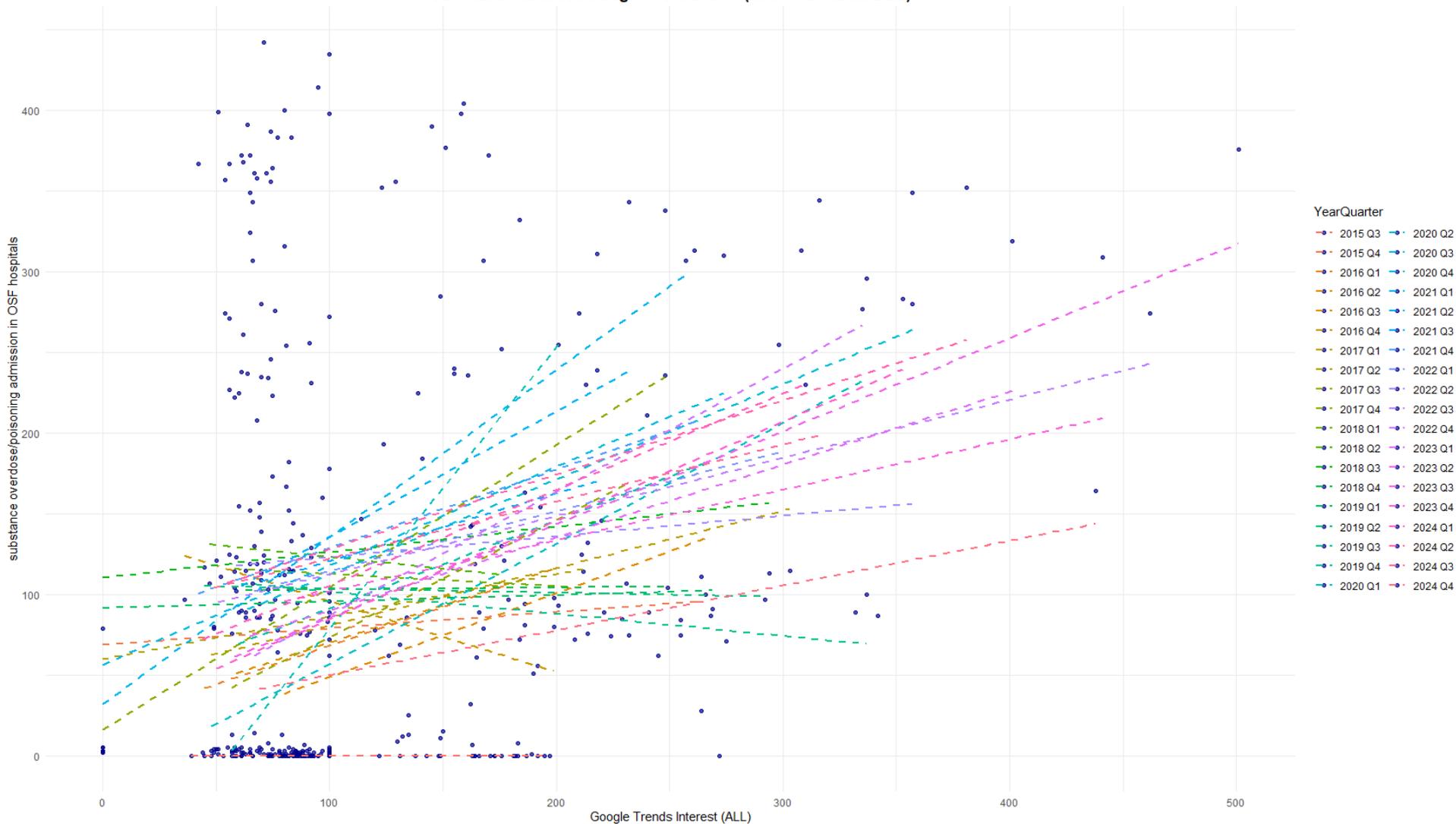
Autoregressive models further indicated a strong association between search queries and substance use admissions, particularly evident in every third quarter.
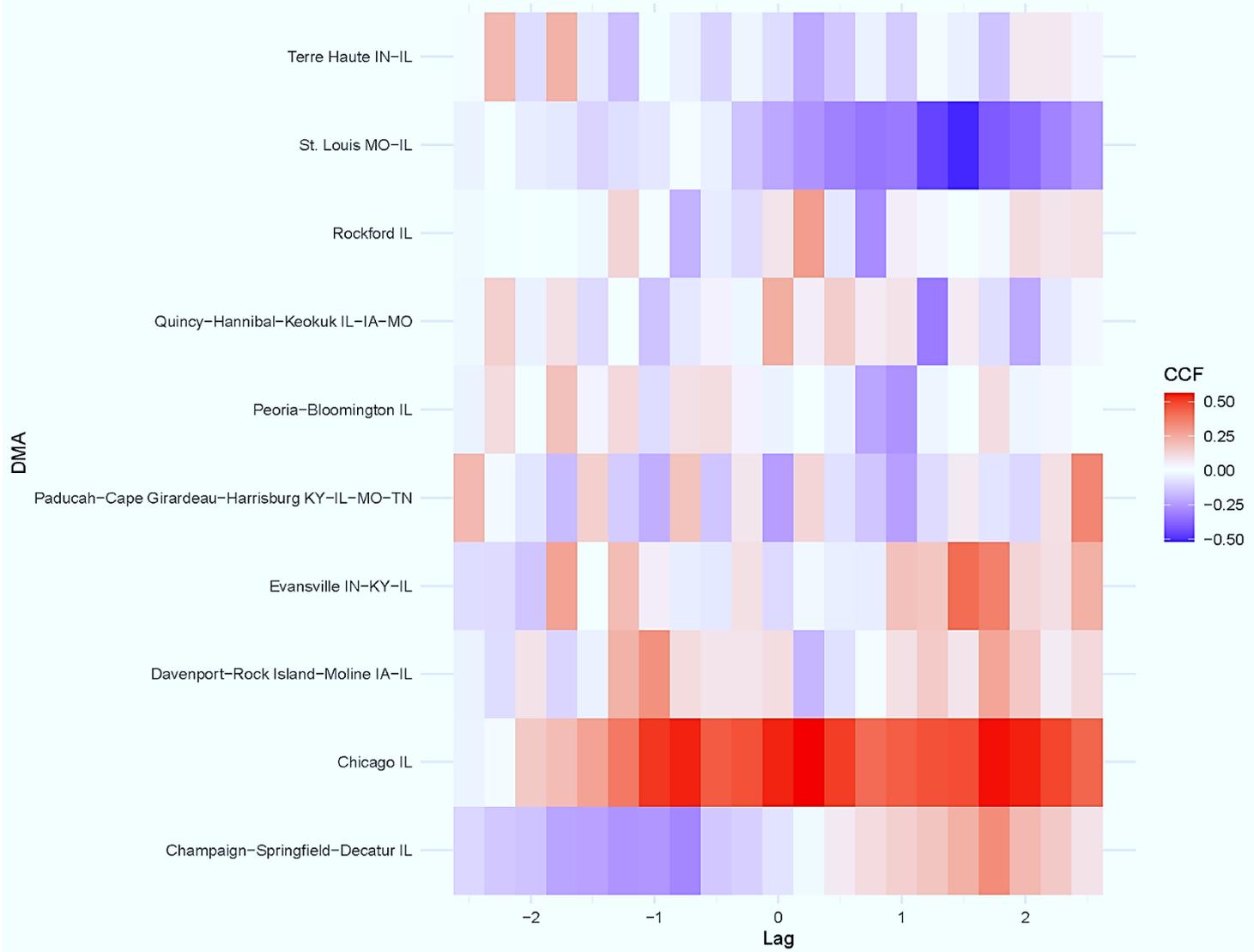

Correlation between Google Trends for ' ' (all GT vs. Admit Data)

Results

Correlation between Google Trends for ' ' (all GT vs. Admit Data)

Search volume vs. substance use admissions. Significant positive correlation (r=0.54) between search queries and hospital admissions (quarterly and yearly).

CCF Heatmap by DMA

Conclusion and Future Work

- Generative AI can provide substance use information that can be used for disease prevention, particularly infections.

- These findings show the potential of GuardianRx as an AI-powered tool for predicting and enabling rapid responses to evolving drug abuse patterns and for proactive public health interventions.

- Not all substance use has an ICD code, which provides a false negative context for flesh-eating drugs

- Further use of text and note analysis and validation of this model using large-scale, retrospectively collected real-world admission datasets is necessary.

References

- Substance Abuse and Mental Health Services Administration. "National Survey on Drug Use and Health: 2020." 2021. [Online]. Available: https://www.samhsa.gov/data/sites/default/files/reports/rpt39443/2021NSDUHFFRRev010323.pdf. Accessed: 2026.02.27.
- DEA. "DEA Joint Intelligence Report: The Growing Threat of Xylazine and Its Mixture with Illicit Drugs." Oct. 2022. [Online]. Available: https://www.dea.gov. Accessed: 2026.02.27.
- Illinois Department of Public Health. "IDPH Opioid Data Dashboard." [Online]. Available: https://dph.illinois.gov/topics- services/opioids/idph-data-dashboard.html. Accessed: 2026.02.27.
- R. Perdue, J. Hawdon, and K. Thames, "Can Big Data Predict the Rise of Novel Drug Abuse?" Journal of Drug Issues, vol. 48, no. 4, pp. 508-518, 2018.
- Chen Dongying, Y. Sun, X. Li, and Z. Yin, "Global burden on drug use disorders from 1990 to 2021 and projections to 2046," *Frontiers in Public Health*, vol. 13, 2025. [Online]. Available: https://www.frontiersin.org/journals/public-health/articles/10.3389/fpubh.2025.1550518. Accessed: 2026.02.27.
- Yu, C., and J. Chen, "Global burden of substance use disorders among adolescents during 1990–2021 and a forecast for 2022–2030: an analysis for the Global Burden of Disease 2021," *BMC Public Health*, vol. 25, art. no. 1012, 2025. [Online]. Available: https://link.springer.com/article/10.1186/s12889-025-22107-6. Accessed: 2026.02.27.

Acknowledgements

- Community Health Advocacy (CHA) Award (a partnership between UIC and OSF Healthcare)

- Dr. Sunita Dodani, Ryan Klute, David McGrew, UICOMP staff

Thank you!